

Project II: Evaluation of new recreational and commercial regulations on catfish in the Ohio River

Project Objectives:

1. Determine abundance (CPUE), size structure, and condition of blue catfish, channel catfish, and flathead catfish in the Ohio River, and evaluate the effects of new regulations on blue, channel, and flathead catfish in the Ohio River, particularly trophy-size catfish.
2. Quantify age, growth, and mortality of the three species in each reach, and compare to previous data to determine if any changes have occurred over time.

Trotline Surveys

After a review of catfish sampling methods used by KDFWR through 2017, it was evident that low-pulse electrofishing provided better estimates on relative abundance and size structure of blue catfish; however, trophy blue catfish were still believed to be underrepresented. In order to combat these issues, trotline methods were altered in 2018 with a larger focus on sampling more fish and more trophy blue catfish. Fresh cut bait of various rough fish species (predominantly smallmouth buffalo and silver carp) were gathered each week. Additionally, the dropper line was switched from 80 lbs test twine to 100 lbs braided line to provide stronger droppers that are also thinner and may be less detectible by catfish. These methods were continued in 2019.

During summer 2019, between July 16 and August 28, trotlines (50 hooks/line) baited with fresh cut rough fish (primarily smallmouth buffalo and silver carp) were used to sample blue catfish. KDFWR crews completed sampling in the Meldahl, Cannelton, and Smithland pools of the Ohio River, and Indiana Department of Natural Resources sampled the JT Myers Pool. One-hundred sixteen total trotlines were fished throughout those pools: 35 in Meldahl Pool, 25 in Cannelton Pool, 32 in JT Myers Pool, and 24 in Smithland Pool (Table 1). CPUE of blue catfish increased from 2018 sampling (Table 2). Blue catfish CPUE (5.9 fish/line) in 2019 was higher than the historical average (2.9 fish/line).

Blue catfish collected with trotlines ranged from 11.4 – 49.2 in with a mean length of 27.5 in (Table 3). Trophy blue catfish were captured in all pools sampled during trotline sampling. Trotline catch rates for different size groups of each species of catfish were also examined (Table 4). Due to the change in trotline methods in 2018, comparisons with previously collected data should be made with caution. Overall, blue catfish CPUE in 2019 was tied for the second highest on record and the highest since trotlining sample sites became standardized in 2011. The 20.0 – 29.9 in and larger size groups were all above the historical averages. CPUE of 20.0 – 29.9 in group (4.2 fish/line) increased from 2018 (3.2 fish/line), while the 30.0 – 34.9 in group CPUE remained unchanged (0.9 fish/line) and trophy CPUE (0.6 fish/line) decreased slightly from 2018 (0.8 fish/line).

Trotline CPUE and size structure of blue catfish in the JT Myers and Smithland pools was lower than expected based on findings in the upper section of the river. Both the Meldahl and Cannelton pools had increased CPUE from 2018 with similar size structure. The majority of commercial effort occurs on the trophy permit section and invasive Asian carp biomass is rapidly increasing in this part of the river, so catch rates and size structure should continue to be monitored closely in the near future. After two years of results, the combination of fresh bait and braided dropper line seemed to produce better catch rates of blue catfish, especially larger fish; therefore mean length of fish sampled has also increased. Trotlining with these new methods should be continued to monitor abundance of larger blue catfish.

Hoop Net Surveys

Commercial hoop net ride-alongs— Data collected from commercial ride-alongs present numerous problems. Commercial fishermen have different levels of experience and knowledge of the river. They often fish different net sizes (both between and among fishermen) and have different soak times. The sample sites are also inconsistent from year to year. These inconsistencies make it impossible to

standardize the sampling and provide the most accurate data. Beginning in 2019, KDFWR stopped conducting commercial ride-alongs for catfish data. Rather, KDFWR sampled with larger (4.0 ft) unbaited hoop nets targeting flathead catfish in addition to standard baited hoop nets targeting channel catfish in 2019.

Channel catfish hoop net surveys—Department hoop netting was conducted in the Meldahl, Cannelton, and Smithland pools to gather data from hoop net catch of channel catfish and flathead catfish. Single nets baited with ZOTE® soap were set overnight for three consecutive net nights in the main stem of the Ohio river from May 9 to June 13. Hoop nets were fished for a total of 180 net-nights: 90 in Meldahl Pool, 60 in Cannelton Pool, and 30 in Smithland Pool (Table 5). Effort was less than the intended 90 net-nights per pool (incomplete sample) in the Cannelton and Smithland pools due to high water and dangerous sampling condition during the sampling window of April - June. Overall catch rate of channel catfish was 4.5 fish/net-night. This is an increase from 3.8 fish/line in 2018, but still well below the 8.0 fish/line in 2017 (Table 6).

Lengths of channel catfish ranged from 3.7 – 29.5 in with a mean length of 16.5 in (Table 7). Hoop net catch rates were also examined for different size groups of channel catfish. Channel catfish catch rates increased from 2018 catch rates for all size groups except ≥ 28.0 in; however, they were all at or below the historical average except for the 20.0 – 27.9 in length group (Table 8).

Flathead catfish hoop net surveys—2019 marked the first year of standardized sampling with 4.0 ft unbaited hoop nets for flathead catfish. Netting was conducted simultaneously with baited channel catfish hoop nets in the Meldahl, Cannelton, and Smithland pools from May 9 through June 13. As such, effort was also less than intended in the Cannelton and Smithland pools due to extended high water and unsafe sampling conditions. Singles nets were set overnight for three consecutive nights in the main stem of the Ohio River. Hoop nets were fished for a total of 174 net-nights: 87 in the Meldahl Pool, 57 in the Cannelton Pool, and 30 in the Smithland Pool (Table 9). Overall CPUE of flathead catfish was 1.8 fish/net-night. This within the range of catch rates observed in previous commercial ride-alongs (Table 10).

Lengths of flathead catfish ranged from 14.0 – 44.5 in with a mean length of 27.5 in (Table 11). Hoop net catch rates of different size groups were also examined, with flathead catfish in the 20.0 – 29.9 in size group displaying the highest CPUE (1.1 fish/net-night; Table 12). Trophy flathead catfish (≥ 35.0 in) were captured at 0.2 fish/net-night, and were observed in all pools sampled, but in much greater numbers in the Meldahl Pool.

Electrofishing Surveys

Low-pulse DC electrofishing was conducted in seven pools in June 2019: Meldahl, Markland, McAlpine, Cannelton, Newburgh, JT Myers, and Smithland. Due to high water and dangerous sampling conditions, only partial samples were completed in the Cannelton, Newburgh, and JT Myers pools. Additionally, sampling in other pools was done at water levels that were higher than sampling typically occurs. A total of 27.0 hr of electrofishing effort was conducted resulting in a total catch of 599 blue catfish and 1,086 flathead catfish (Table 13). Overall CPUE of blue catfish was 22.2 fish/hr and above the historical average of 17.0 fish/hr (Table 14). Overall flathead catfish CPUE was also 40.2 fish/hr and above the historical average (32.9 fish/hr).

Blue catfish collected with electrofishing ranged from 4.6 – 48.2 in with a mean length of 18.6 in (Table 15). Electrofishing catch rates were also examined for different size groups of blue catfish. Though down from the previous year, CPUE of all size classes examined was above the historical average except for the 12.0 – 19.9 in size group despite unfavorable sampling conditions (Table 16). Trophy blue catfish were observed in all pools except Markland and Cannelton (incomplete sample). This marks the second consecutive year that no trophy blue catfish were captured in the Markland Pool.

Flathead catfish lengths ranged from 3.0 – 46.2 in with a mean length of 15.8 in (Table 15). Electrofishing

CPUE for all size groups examined were all above their historical averages, but all size groups also decreased from 2018 levels (Table 17). Trophy flathead catfish were observed in all pools sampled except Newburgh (incomplete sample).

Five direct tributaries to the Ohio River (Licking River, Kentucky River, Green River, Cumberland River, and Tennessee River) that allow commercial fishing were also sampled with electrofishing (Table 18). Sampling in the Cumberland and Tennessee Rivers occurred at river levels higher than preferred. With the exception of Green River, all tributaries sampled had lower catch rates of blue catfish and flathead catfish than the Ohio River in 2019. Additionally, trophy blue catfish and flathead catfish were not as common as in the main stem Ohio River (Table 19). No trophy catfish were captured in the Licking or Tennessee rivers, and very few fish larger than 30.0 in were captured with the exception of in the Green River.

Relative Weight

Relative weight (W_r) was also calculated for each species of catfish. Fish collected from all sampling methods used in 2019 were combined to provide a more representative estimate for the entire populations of each catfish species. Overall W_r of blue catfish (N=954) in 2019 was 99, the lowest since 2013 but still in good condition (Table 20). Overall relative weight of channel catfish (N=655) was 86 and was also the lowest since 2013. Flathead catfish (N=1,021) overall relative weight was 99. Overall, blue catfish and flathead catfish appear to be in good condition throughout the river, while channel catfish relative weights are consistently below 100.

Age, Growth, and Mortality

In spring 2017, otoliths (up to 5 per inch class for fish <30.0 in and up to 3 per inch class for fish \geq 30.0 in) were taken from blue catfish, channel catfish, and flathead catfish to assess growth rates for each species. Separate samples were taken from the upper and trophy permit sections. Von Bertalanffy growth equations were calculated by river section and sex for each species (Table 21). Male blue catfish seemed to grow faster in the upper section, but the opposite was observed in the trophy permit section. On average, it took blue catfish 17.7 years to reach trophy size (\geq 35.0 in; Table 22). Channel catfish exhibited slightly faster growth in the upper section of the Ohio River, but no large differences were seen in growth between sexes. Overall, channel catfish reached trophy size (28.0 in) at 20.0 years (Table 23). There was no noticeable difference in growth rates of flathead catfish between sexes; however, flathead catfish exhibited faster growth in the trophy permit section of the Ohio River. On average a flathead catfish in the upper section reached trophy size (35.0 in) at 20.6 years, while flathead catfish in the trophy permit section reached trophy size nearly three years quicker at 17.7 years. Overall, flathead catfish reached trophy size at 20.1 years (Table 24). Growth of all three species of catfish sampled was extremely variable, particularly as fish grew older and larger, with some fish growing much slower than the Von-Bertalanffy model described and some growing much faster.

Total annual mortality estimates were made on all three species of catfish based off length-at-age of capture data from otoliths and paired with unaged catfish collected with multiple sampling techniques in 2017. Length frequency data from 2019 was paired with the 2017 age-length key to provide mortality estimates for 2019. Using Fishery Analysis and Modeling Simulator (FAMS), a separate weighted catch-curve regression was run on each species of catfish for each sampling method to calculate a range of total annual mortality estimates. As a precautionary step, the highest mortality estimate calculated for each species is reported to avoid underestimates and potentially masking problems in the populations. In 2019, river-wide total annual mortality for blue catfish was 17.3% (Table 25). Channel catfish total annual mortality was 23.3%, and flathead catfish total annual mortality was 17.1%. All species had lower estimated mortality rates than in the previous year, and blue catfish was the lowest since 2013.

Commercial Fishing Industry

Commercial fishing for catfish has long been present in the Ohio River, but recent concerns of potential overharvest have warranted further investigations. Harvest of blue catfish began increasing from 2004 to 2005 and has remained near 200,000 lbs through 2018 with the exception of large peaks in 2012 as well as in 2016 and 2017 (Figure 1). Channel catfish harvest has fluctuated, but generally increased from 2007 – 2012 and has gradually declined since 2012. Channel catfish harvest was around 150,000 lbs for each of the years from 2014 – 2017, and saw a decline to just under 100,000 lbs in 2019. Flathead catfish trends are similar to channel catfish; however, harvest has been below average the past five years. Unfortunately, commercial fish harvest reports do not include detailed information about gear (number of net nights, baited vs. unbaited, length of gillnet, etc.); however, the number of hooks fished for trotlines as well as number of hoop nets fished is required to be reported. Although trotline and hoop net harvest should not be considered indicative of the entire commercial catfish harvest, it is the best available method to analyze trends in commercial catfish harvest rates. Effort (number of hooks for trotlines and number of nets for hoop nets) and pounds harvested by method were examined to determine if harvest rates varied over the years. Trotlines are more effective at capturing blue catfish, while hoop nets are more effective when targeting flathead catfish according to commercial harvest data. Channel catfish appear to be captured efficiently by both trotlines and hoop nets. Each species was examined according to the most effective gear. The harvest rate of blue catfish increased sharply from 2004 to 2005, then increased gradually from 2005 – 2019, and is currently at an all-time high for the fourth consecutive year (Figure 2). Recent decreases in total pounds of catfish harvested in 2013, 2014, and 2018 described above are likely not a result of decreased harvest rates, but rather a decrease in effort. Channel catfish trotline harvest rates has been extremely consistent since 2004 (Figure 2). Channel catfish and flathead catfish harvest in commercial nets have both remained between 5 – 15 pounds/net; however, a drastic spike in harvest occurred in 2012 and 2013 (Figure 3). Reasons for this extreme peak in harvest are not known, but could be a result of prolonged favorable fishing conditions or demand for fish.

Table 1. CPUE (fish/line) of blue catfish collected during trotline surveys on the Ohio River in summer 2019. Standard errors are in parentheses.

Pool	No. of trotlines	No. of Blue Catfish	CPUE
Meldahl	35	270	7.7 (0.9)
Cannelton	25	170	6.8 (0.7)
JT Myers	32	160	5.0 (0.5)
Smithland	24	81	3.4 (0.5)
Total	116	681	5.9 (0.4)

Table 2. CPUE (fish/line) of blue catfish collected during trotline surveys on the Ohio River during summer from 2004 - 2019. Standard errors are in parentheses.

Year	CPUE
2004	1.5 (0.3)
2005	1.5 (0.4)
2006	6.6 (1.2)
2007	2.4 (0.5)
2008	5.9 (0.7)
2010	4.0 (0.4)
2011	3.9 (0.6)
2012	3.0 (0.8)
2013	1.2 (0.2)
2014	1.3 (0.1)
2015	1.6 (0.2)
2016	2.8 (0.2)
2017	2.0 (0.2)
2018*	5.2 (0.4)
2019*	5.9 (0.4)
Mean**	2.9 (0.5)

*New methods were adopted for trotlining including changes in bait and style of dropper lines.

**Mean calculated from 2004 - 2017 data prior to changing methods.

Table 3. Length frequency and CPUE (fish/line) of blue catfish collected during trotline surveys on Ohio River in summer 2019. Standard errors are in parentheses.

Pool	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	Total	CPUE
Meldahl	1				1			1	1	2	12	25	29	24	31	20	17	17	22	11	6	9	8	7	3	2	4	2	2	2	6	1	2		1	1			270	7.7 (0.9)	
Cannelton		1					1	1	1	4	7	21	20	14	21	7	13	6	4	8	3	2	3	6	4	2	6		1	1	4	2	2	2	1		1	1		170	6.8 (0.7)
JT Myers			1		2	1	1	1	5	3	4	13	17	16	20	12	14	14	10	7	1	4	1	5	3	2	1											1	160	5.0 (0.5)	
Smithland								1	1		1		4	4	8	11	9	7	6	8	6	3		3	1	1	2	2	2										81	3.4 (0.5)	
Total	1	1	1		3	1	2	4	8	9	24	59	70	58	80	50	53	44	42	34	16	18	12	21	11	7	13	4	6	3	10	4	4	2	2		2	1	1	681	5.9 (0.4)

Table 4. CPUE (fish/line) by size group of blue catfish collected during trotline surveys on the Ohio River during summer from 2004 - 2019. Standard errors are in parentheses.

Year	Size group (in)					Total
	<12.0	12.0 - 19.9	20.0 - 29.9	30.0 - 34.9	≥35.0	
2004	0.0	0.3 (0.2)	0.9 (0.2)	0.3 (0.2)	0.1 (0.1)	1.5 (0.3)
2005	0.0	<0.1 (<0.1)	1.0 (0.6)	0.2 (0.1)	0.2 (0.1)	1.5 (0.4)
2006	<0.1 (<0.1)	0.8 (0.2)	5.0 (1.0)	0.6 (0.2)	0.2 (0.1)	6.6 (1.2)
2007	0.0	0.3 (0.1)	1.5 (0.4)	0.5 (0.2)	0.1 (<0.1)	2.4 (0.5)
2008	0.0	0.6 (0.2)	4.1 (0.8)	1.0 (0.1)	0.1 (0.1)	5.9 (0.7)
2010	0.0	0.2 (<0.1)	1.9 (0.3)	1.1 (0.3)	0.7 (0.2)	4.0 (0.4)
2011	0.0	0.2 (0.1)	2.7 (0.5)	0.9 (0.3)	0.3 (0.1)	3.9 (0.6)
2012	0.1 (<0.1)	0.7 (0.3)	1.7 (0.3)	0.3 (0.2)	0.2 (0.1)	3.0 (0.8)
2013	0.1 (<0.1)	0.3 (0.1)	0.6 (0.1)	0.1 (<0.1)	<0.1 (<0.1)	1.2 (0.2)
2014	<0.1 (<0.1)	0.5 (0.1)	0.5 (0.1)	0.2 (<0.1)	0.1 (0.1)	1.3 (0.1)
2015	<0.1 (<0.1)	0.5 (0.2)	0.7 (0.2)	0.3 (0.1)	0.1 (<0.1)	1.6 (0.2)
2016	<0.1 (<0.1)	0.7 (0.2)	1.5 (0.4)	0.5 (0.2)	0.1 (<0.1)	2.8 (0.2)
2017	0.0	0.3 (0.1)	1.4 (0.1)	0.2 (<0.1)	0.1 (<0.1)	2.0 (0.2)
2018*	<0.1 (<0.1)	0.3 (0.1)	3.2 (0.3)	0.9 (0.1)	0.8 (0.1)	5.2 (0.4)
2019*	<0.1 (<0.1)	0.2 (<0.1)	4.2 (0.3)	0.9 (0.1)	0.6 (0.1)	5.9 (0.4)
Mean**	<0.1 (<0.1)	0.4 (0.1)	1.8 (0.4)	0.5 (0.1)	0.2 (<0.1)	2.9 (0.5)

*New methods were adopted for trotlining including changes in bait and style of dropper lines.

**Mean calculated from 2004 - 2017 data prior to changing methods.

Table 5. CPUE (fish/net-night) of channel catfish collected during baited hoop net surveys in Meldahl, Cannelton, and Smithland pools of the Ohio River in spring 2019. Standard errors are in parentheses.

Pool	Effort (net nights)	No. of Channel Catfish	CPUE
Meldahl	90	418	4.6 (1.1)
Cannelton*	60	335	5.6 (1.6)
Smithland*	30	49	1.6 (0.7)
Total*	180	802	4.5 (0.8)

*Incomplete sample due to high water

Table 6. CPUE (fish/net-night) of channel catfish collected during baited hoop net surveys on the Ohio River in spring 2017 - 2019. Standard errors are in parentheses.

Year	CPUE
2017	8.0 (1.1)
2018	3.8 (0.5)
2019*	4.5 (0.8)
Mean	4.9 (0.4)

*Incomplete sample due to high water

Table 7. Length frequency and CPUE (fish/net-night) of channel catfish collected during baited hoop net sampling in the Meldahl, Cannelton, and Smithland pools during spring 2019 on the Ohio River. Standard errors are in parentheses.

Pool	Length (in)																													Total	CPUE
	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29				
Meldahl					1	4	11	13	23	20	18	26	30	35	31	44	36	25	23	21	18	14	17	3	3	2	418	4.6 (1.1)			
Cannelton*	1				2	7	37	28	10	25	35	41	28	29	27	19	19	12	8	2		2	2	1		335	5.6 (1.6)				
Smithland*					2		5	2	1	1	2	1	1		3	2	1	5	4	4	4	3	4	2	1	1	49	1.6 (0.7)			
Total*	1				3	13	48	46	35	46	54	69	59	65	58	66	57	38	36	27	22	20	22	8	5	3	1	802	4.5 (0.8)		

*Incomplete sample due to high water

Table 8. CPUE (fish/net-night) by size group of channel catfish collected during baited hoop net surveys on the Ohio River in spring 2017 - 2019. Standard errors are in parentheses.

Year	Size group (in)				Total
	<12.0	12.0 - 19.9	20.0 - 27.9	≥28.0	
2017	1.5 (0.3)	4.5 (0.7)	1.0 (0.2)	<0.1 (<0.1)	7.0 (1.0)
2018	0.7 (0.1)	2.5 (0.4)	0.6 (0.1)	<0.1 (<0.1)	3.8 (0.5)
2019*	0.8 (0.2)	2.6 (0.5)	1.0 (0.3)	<0.1 (<0.1)	4.5 (0.8)
Mean	1.0 (0.1)	3.2 (0.3)	0.8 (0.1)	<0.1 (<0.1)	4.9 (0.4)

*Incomplete sample due to high water

Table 9. CPUE (fish/net-night) of flathead catfish collected during unbaited hoop net surveys in Meldahl, Cannelton, and Smithland pools of the Ohio River in spring 2019. Standard errors are in parentheses.

Pool	Effort (net nights)	No. of Flathead Catfish	CPUE
Meldahl	87	189	2.2 (0.4)
Cannelton*	57	79	1.4 (0.3)
Smithland*	30	47	1.6 (0.5)
Total*	174	315	1.8 (0.2)

*Incomplete sample due to high water

Table 10. CPUE (fish/net-night) of flathead catfish collected during commercial hoop net ride-alongs on the Ohio River in spring 2013 - 2018. Standard errors are in parentheses.

Year	CPUE
2013	2.6 (0.3)
2014	0.8 (0.1)
2015	0.7 (0.3)
2017	1.1 (0.4)
2018	1.4 (0.3)
Mean	1.3 (0.3)

Table 11. Length frequency and CPUE (fish/net/night) of flathead catfish collected during unbaited hoop net sampling in the Meldahl, Cannelton, and Smithland pools during spring 2019 on the Ohio River. Standard errors are in parentheses.

Pool	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	Total	CPUE
Meldahl				2	1	3	3	6	11	5	13	22	14	12	9	14	15	12	6	8	4	7	6	3	1	3	4	3		1	1	189	2.2 (0.4)
Cannelton*						7	4	7	9	9	8	5	3	5	2	3	2	2	1	3	2	3	3		1							79	1.4 (0.3)
Smithland*	1	1			2	4	3	3	6	2	4	3	2	2	1	4	1		1	2	1	1	3									47	1.6 (0.5)
Total*	1	1		2	3	14	10	16	26	16	25	30	19	19	12	21	18	14	8	13	7	11	12	3	2	3	4	3		1	1	315	1.8 (0.2)

*Incomplete sample due to high water

Table 12. CPUE (fish/net-night) by size group of flathead catfish collected during unbaited hoopnet surveys on the Ohio River in spring 2019. Standard errors are in parentheses.

Size group (in)					
<12.0	12.0 - 19.9	20.0 - 29.9	30.0 - 34.9	≥35.0	Total
0.0	0.1 (<0.1)	1.1 (0.1)	0.3 (0.1)	0.2 (0.1)	1.8 (0.2)

Table 13. Effort and CPUE (fish/hr) of blue catfish and flathead catfish collected during electrofishing surveys on the Ohio River in June 2019. Standard errors are in parentheses.

Pool	No. of transects	Effort (hr)	No. of Blue Catfish	CPUE	No. of Flathead	CPUE
Meldahl	20	5.0	135	27.0 (6.3)	264	52.8 (4.3)
Markland	20	5.0	128	25.6 (7.6)	118	23.6 (3.4)
McAlpine	20	5.0	71	14.2 (5.2)	174	34.8 (5.1)
Cannelton*	8	2.0	36	18.0 (4.5)	59	29.5 (6.8)
Newburgh*	4	1.0	5	5.0 (1.9)	50	50.0 (2.6)
JT Myers*	16	4.0	86	21.5 (5.8)	234	58.5 (6.2)
Smithland	20	5.0	138	27.6 (6.7)	187	37.4 (6.4)
Total*	108	27.0	599	22.2 (2.6)	1086	40.2 (2.4)

*Incomplete sample due to high water

Table 14. CPUE (fish/hr) of blue catfish and flathead catfish collected during electrofishing surveys on the Ohio River from 2004 - 2019. Standard errors are in parentheses.

Year	Species	
	Blue catfish	Flathead catfish
2004	0.0	14.5 (4.1)
2009	1.6 (0.8)	15.5 (4.1)
2010	11.9 (4.0)	17.1 (3.3)
2013	11.4 (4.8)	38.9 (5.1)
2014	19.3 (3.2)	32.8 (2.6)
2015	19.0 (3.8)	37.6 (3.6)
2016	17.5 (2.7)	35.5 (2.2)
2017	25.2 (2.7)	40.6 (2.1)
2018	39.8 (5.7)	54.0 (4.7)
2019*	22.2 (2.6)	40.2 (2.4)
Mean	17.0 (3.7)	32.9 (4.1)

*Incomplete sample due to high water

Table 17. CPUE (fish/hr) by size group of flathead catfish collected during electrofishing surveys on the Ohio River from 2004 - 2019. Standard errors are in parentheses.

Year	Size group (in)					Total
	<12.0	12.0 - 19.9	20.0 - 29.9	30.0 - 34.9	≥35.0	
2004	9.3 (4.2)	5.0 (1.1)	0.3 (0.3)	0.0	0.0	14.5 (4.1)
2009	8.4 (1.7)	4.3 (0.2)	2.6 (0.2)	0.0	0.3 (<0.1)	15.5 (4.1)
2010	8.8 (1.9)	6.0 (2.1)	2.1 (0.5)	0.2 (<0.1)	0.0	17.1 (3.3)
2013	14.9 (4.5)	17.2 (1.1)	6.3 (1.8)	0.3 (0.1)	0.2 (0.2)	38.9 (5.1)
2014	12.3 (2.6)	15.9 (3.7)	4.3 (0.2)	0.3 (0.1)	0.1 (<0.1)	32.8 (2.6)
2015	15.8 (2.1)	14.6 (4.2)	5.6 (0.9)	0.9 (0.4)	0.7 (0.3)	37.6 (3.6)
2016	10.9 (1.6)	16.0 (4.2)	7.2 (1.3)	0.8 (0.3)	0.6 (0.3)	35.5 (2.2)
2017	12.5 (1.1)	15.5 (1.0)	10.7 (0.9)	1.1 (0.2)	0.8 (0.2)	40.6 (2.1)
2018	22.0 (2.8)	15.3 (1.0)	13.5 (1.2)	1.9 (0.3)	1.2 (0.2)	54.0 (4.7)
2019*	15.0 (1.8)	12.9 (0.9)	10.1 (0.8)	1.4 (0.3)	0.8 (0.2)	40.2 (2.4)
Mean	13.0 (1.4)	12.3 (1.6)	6.3 (1.3)	0.7 (0.2)	0.5 (0.1)	32.9 (4.1)

*Incomplete sample due to high water

Table 18. Effort and CPUE (fish/hr) of blue catfish and flathead catfish collected during electrofishing surveys on commercially fishable tributaries of the Ohio River in May/June 2019. Standard errors are in parentheses.

Tributary	No. of transects	Effort (hr)	No. of blue catfish	CPUE	No. of flathead catfish	CPUE
Licking River	8	2.0	22	11.0 (5.2)	28	14.0 (3.5)
Kentucky River	16	4.0	33	8.3 (2.6)	97	24.3 (4.0)
Green River	16	4.0	155	38.8 (6.4)	162	40.5 (4.7)
Cumberland River	12	3.0	24	8.0 (3.0)	97	32.3 (11.3)
Tennessee River	8	2.0	0	0.0	12	6.0 (2.0)

Table 21. von Bertalanffy growth parameters used to estimate length-at age for blue catfish, channel catfish, and flathead catfish collected from the Ohio River in 2017 where L_{∞} = theoretical maximum length, K =body growth coefficient, and t_0 =time coefficient.

Parameter	Blue catfish	Channel catfish	Flathead catfish
L_{∞} (in)	55.0	35.0	55.0
K	0.051	0.074	0.040
t_0	-2.086	-1.783	-4.556

Table 22. Mean length (in) at age calculated with the von Bertalanffy growth equation based on otoliths taken from blue catfish from the Ohio River in spring and summer of 2017.

Section	Sex	Age																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Upper	Male	7.2	9.9	12.4	14.8	17.1	19.3	21.3	23.2	25.0	26.7	28.3	29.8	31.2	32.6	33.8	35.0	36.2	37.2	38.2	39.2
	Female	9.7	11.6	13.5	15.2	16.9	18.5	20.0	21.5	22.9	24.3	25.6	26.8	28.0	29.2	30.2	31.3	32.3	33.3	34.2	35.1
	Total	7.6	10.0	12.4	14.6	16.7	18.6	20.5	22.3	24.0	25.6	27.1	28.6	29.9	31.2	32.5	33.6	34.8	35.8	36.8	37.7
Trophy permit	Male	9.0	11.2	13.4	15.4	17.3	19.2	20.9	22.6	24.2	25.7	27.1	28.5	29.8	31.0	32.2	33.3	34.4	35.4	36.4	37.3
	Female	7.3	9.9	12.4	14.7	16.9	19.0	20.9	22.8	24.6	26.2	27.8	29.3	30.7	32.0	33.3	34.5	35.6	36.7	37.7	38.6
	Total	8.3	10.6	12.8	14.9	16.9	18.8	20.6	22.3	24.0	25.5	27.0	28.4	29.7	31.0	32.2	33.3	34.4	35.4	36.4	37.3
Overall	Male	8.7	11.1	13.3	15.4	17.4	19.4	21.2	22.9	24.5	26.1	27.5	28.9	30.3	31.5	32.7	33.9	34.9	36.0	36.9	37.9
	Female	11.9	13.4	15.0	16.4	17.8	19.2	20.5	21.7	23.0	24.1	25.3	26.3	27.4	28.4	29.4	30.3	31.2	32.1	32.9	33.7
	Total	8.0	10.4	12.6	14.7	16.7	18.6	20.4	22.2	23.8	25.4	26.8	28.2	29.6	30.9	32.1	33.2	34.3	35.3	36.3	37.2

Table 23. Mean length (in) at age calculated with the von Bertalanffy growth equation based on otoliths taken from channel catfish from the Ohio River in spring and summer of 2017.

Section	Sex	Age																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Upper	Male	6.6	9.1	11.5	13.6	15.6	17.3	18.9	20.4	21.7	22.9	24.0	25.0	25.9	26.7	27.5	28.2	28.8	29.3	29.9	30.3
	Female	5.7	8.7	11.5	13.9	16.1	18.1	19.8	21.4	22.8	24.1	25.2	26.3	27.2	28.0	28.7	29.4	30.0	30.5	30.9	31.4
	Total	6.4	8.9	11.1	13.2	15.0	16.8	18.3	19.8	21.1	22.3	23.4	24.4	25.3	26.1	26.9	27.6	28.2	28.8	29.3	29.8
Trophy permit	Male	7.8	9.5	11.1	12.6	14.0	15.3	16.5	17.6	18.7	19.7	20.7	21.6	22.4	23.2	23.9	24.6	25.2	25.8	26.4	26.9
	Female	8.0	9.7	11.2	12.7	14.1	15.5	16.7	17.8	18.9	19.9	20.9	21.8	22.6	23.4	24.1	24.8	25.4	26.0	26.6	27.1
	Total	7.6	9.4	11.1	12.7	14.1	15.5	16.8	18.0	19.1	20.1	21.1	22.0	22.9	23.7	24.4	25.1	25.8	26.4	26.9	27.5
Overall	Male	7.4	9.5	11.4	13.2	14.9	16.4	17.8	19.1	20.3	21.4	22.5	23.4	24.3	25.1	25.9	26.6	27.2	27.8	28.3	28.8
	Female	7.8	9.6	11.3	12.9	14.4	15.8	17.1	18.3	19.4	20.5	21.5	22.4	23.2	24.0	24.8	25.5	26.1	26.7	27.3	27.8
	Total	6.5	8.5	10.4	12.2	13.8	15.3	16.7	18.0	19.2	20.4	21.4	22.4	23.3	24.1	24.9	25.6	26.3	26.9	27.5	28.0

Table 24. Mean length (in) at age calculated with von Bertalanffy growth equation based on otoliths taken from flathead catfish from the Ohio River in spring and summer of 2017.

Section	Sex	Age																																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Upper	Male	9.4	11.3	13.0	14.7	16.3	17.9	19.4	20.8	22.2	23.5	24.8	26.0	27.2	28.3	29.4	30.4	31.4	32.4	33.3	34.2	35.0	35.8	36.6	37.3	38.0	38.7	39.4	40.0	40.6	41.2	41.8	42.3	42.8
	Female	11.3	13.1	14.8	16.4	18.0	19.5	20.9	22.3	23.6	24.9	26.1	27.2	28.4	29.4	30.5	31.5	32.4	33.3	34.2	35.0	35.8	36.6	37.4	38.1	38.8	39.4	40.0	40.6	41.2	41.8	42.3	42.8	43.3
	Total	11.0	12.7	14.4	16.0	17.5	19.0	20.4	21.8	23.1	24.3	25.5	26.7	27.8	28.9	29.9	30.9	31.8	32.8	33.6	34.5	35.3	36.1	36.8	37.5	38.2	38.9	39.5	40.1	40.7	41.3	41.8	42.3	42.8
Trophy permit	Male	5.7	8.3	10.8	13.1	15.3	17.4	19.4	21.3	23.1	24.7	26.3	27.8	29.3	30.6	31.9	33.1	34.3	35.4	36.4	37.4	38.3	39.2	40.1	40.9	41.6	42.3	43.0	43.6	44.2	44.8	45.3	45.9	46.3
	Female	5.2	7.8	10.4	12.8	15.0	17.2	19.2	21.1	22.9	24.7	26.3	27.8	29.3	30.7	32.0	33.2	34.4	35.5	36.6	37.5	38.5	39.4	40.2	41.0	41.8	42.5	43.2	43.8	44.4	45.0	45.5	46.0	46.5
	Total	5.6	8.2	10.7	13.0	15.2	17.3	19.3	21.2	23.0	24.7	26.3	27.8	29.2	30.6	31.9	33.1	34.2	35.3	36.4	37.4	38.3	39.2	40.0	40.8	41.6	42.3	43.0	43.6	44.2	44.8	45.3	45.8	46.3
Overall	Male	8.8	10.7	12.6	14.3	16.0	17.6	19.2	20.6	22.0	23.4	24.7	26.0	27.2	28.3	29.4	30.5	31.5	32.5	33.4	34.3	35.1	36.0	36.8	37.5	38.2	38.9	39.6	40.2	40.8	41.4	42.0	42.5	43.0
	Female	9.3	11.3	13.2	15.0	16.7	18.3	19.9	21.4	22.9	24.3	25.6	26.9	28.1	29.3	30.4	31.4	32.5	33.4	34.4	35.3	36.1	36.9	37.7	38.5	39.2	39.9	40.5	41.2	41.8	42.3	42.9	43.4	43.9
	Total	7.6	9.6	11.6	13.6	15.4	17.1	18.8	20.4	21.9	23.4	24.8	26.1	27.4	28.6	29.8	30.9	32.0	33.0	34.0	34.9	35.8	36.6	37.4	38.2	39.0	39.7	40.4	41.0	41.6	42.2	42.8	43.3	43.8

Table 25. Maximum total annual mortality rates of blue catfish, channel catfish, and flathead catfish collected from the Ohio River using trotlines, hoopnets, and electrofishing from 2013 - 2019.

Year	Species		
	Blue catfish	Channel catfish	Flathead catfish
2013	18.7	32.2	18.8
2014	24.7	26.8	18.7
2015	20.0	20.6	15.9
2016	17.4	16.8	16.0
2017	18.9	27.9	18.2
2018	19.8	28.0	18.0
2019	17.3	23.3	17.1
Mean	19.5	25.1	17.5

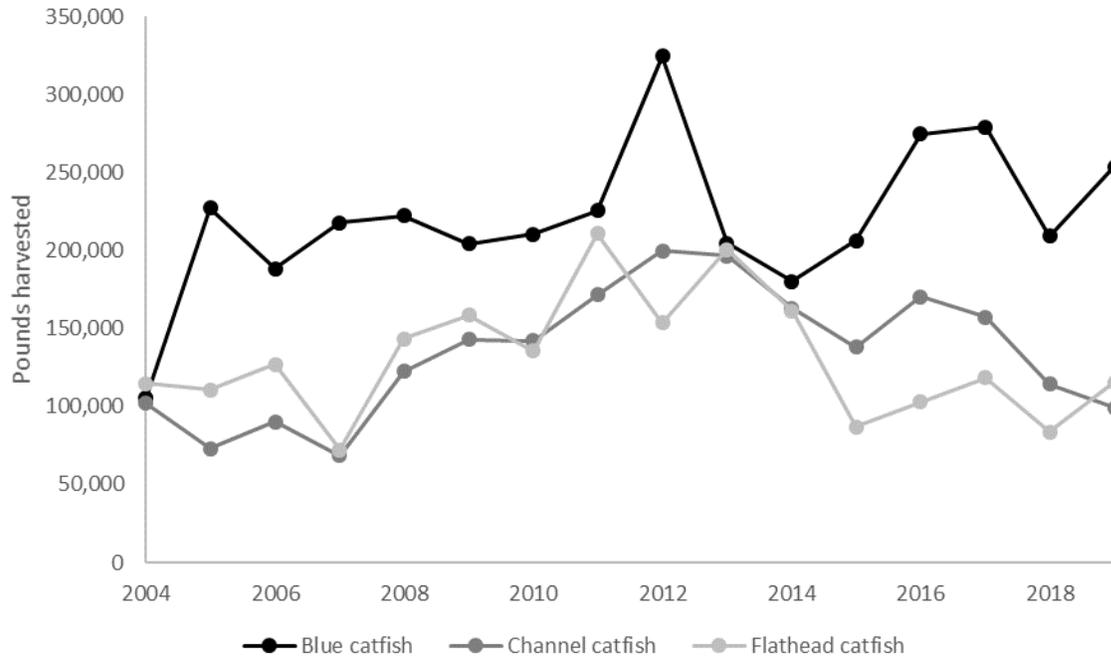


Figure 1. Total pounds of blue catfish, channel catfish, and flathead catfish harvested by commercial fishermen from the Ohio River from 2004 – 2019.

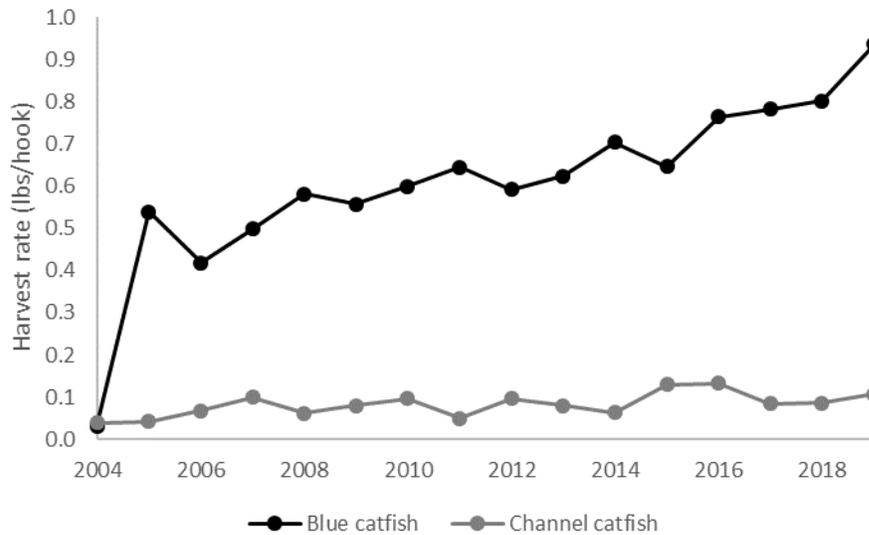


Figure 2. Harvest rate (lbs/hook) of blue catfish and channel catfish harvested with trotlines by commercial fishermen from the Ohio River from 2004 – 2019.

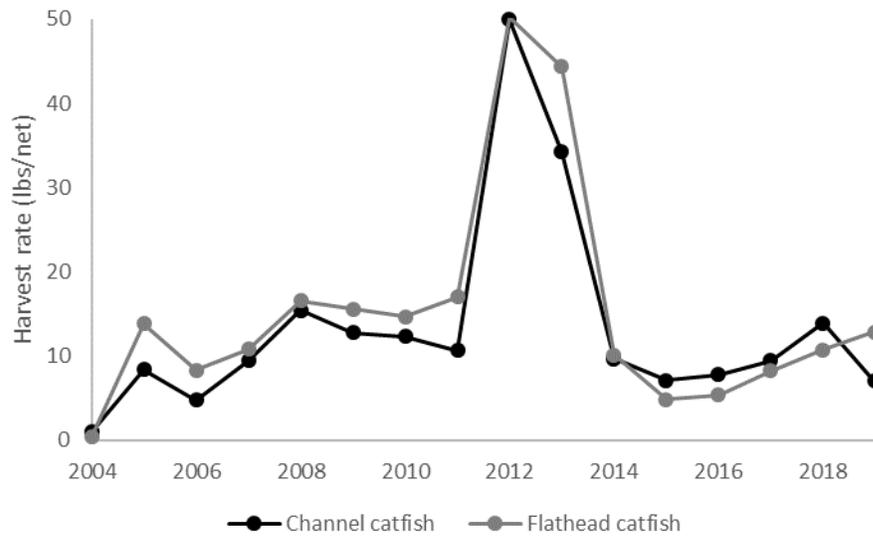


Figure 3. Harvest rate (lbs/net) of channel catfish and flathead catfish harvested with hoop nets by commercial fishermen from the Ohio River from 2004 – 2019.